Economic impacts of restoring rangelands: A CGE approach

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1. Introduction

This paper evaluates the potential economic impacts of restoring Jordan's rangelands, a critical component of the country's economy, environment, and culture. The rangelands in Jordan have experienced severe degradation over recent decades due to a combination of environmental, social, and political factors. These include climate change, overgrazing, urban expansion, and the conversion of rangelands into cropland. This degradation has significantly reduced the availability of natural pastures, which are crucial for sustaining the extensive small ruminant sector, a key component of Jordan's agricultural output and exports (IFA, 2020). Moreover, pastoralist communities depend on livestock for their livelihoods, making the restoration of rangelands a key policy objective. In addition to their economic importance, rangelands which are not degraded provide significant recreational and ecotourism services for both pastoralist and non-pastoralist communities (Albalawneh et al., 2022). However, most existing economic evaluations of restoration interventions in Jordan focus narrowly on specific regions or markets, often ignoring broader, economy-wide effects. This highlights the need for a more comprehensive analysis that considers the complex interactions between the economy and the environment.

Given the economic importance of rangelands in Jordan, in this study we use a general equilibrium approach to evaluate the broader economic impacts of rangeland restoration. One promising restoration technique that has been trailed is micro water harvesting (MWH), which involves establishing contour ridges in degraded areas and planting grazing shrub seedlings This technique has been trialed in different rangeland ecosystems, showing positive results,

including improved vegetation cover forage availability (Strohmeier et al., 2021). Importantly, MWH is cost-effective and widely applicable throughout the country, making it an attractive option for scaling up in Jordan's rangelands (Haddad, 2021). This study explores the economic implications of implementing MWH on a national scale, focusing on two primary outcomes: the increase in the supply of natural fodder and the associated restoration costs.

2. Methodes and data

To assess these economic impacts, we adapt the STAGE 2 model developed by McDonald & Thierfielder (2015), which is a general equilibrium framework suited to capture both market and non-market economic interactions. On the production side, we modify the small ruminant sector of the model by introducing a nested structure that allows for substitution between natural fodder and imported, subsidized grains and concentrated feed. This substitution effect is critical, as it influences the cost structure of livestock production. On the demand side, we introduce recreation as a non-consumptive good, combined with market consumption goods and leisure to comprise the household utility. This modification enables us to capture the value of recreational services that rangelands provide, which is crucial for understanding the multiple benefits associated with their restoration.

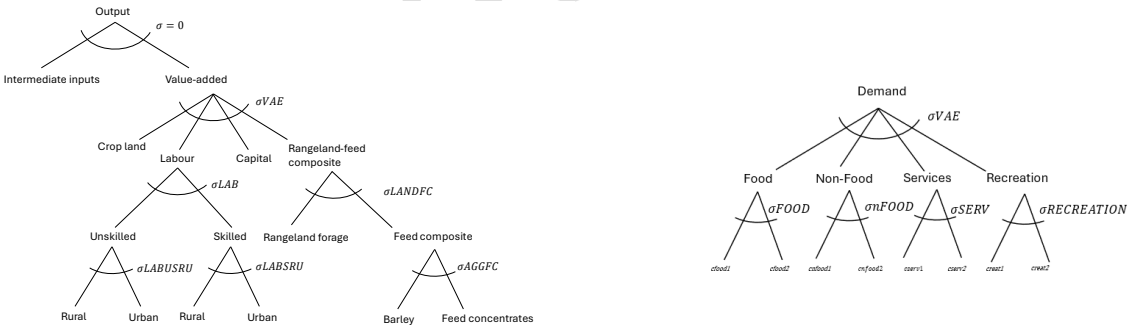

Figure 1: Extended nesting structures for supply and demand

Our model is calibrated to an extended version of the Social Accounting Matrix (SAM) developed by Raouf et al. (2021). This extended SAM includes the small ruminants' sector and introduces a new rangelands sector**,** which produces two goods: natural fodder (used as an input in small ruminant production) and landscape service that is demanded by households for recreation. We follow the United Nations System of Environmental-Economic Accounting

(SEEA) framework to value these goods in the SAM. The natural fodder is valued using the residual rent method, while landscape services are valued using the travel cost method**.**

The simulation scenario is based on experimental data from ICARDA's rangeland rehabilitation trials in Amman, Jordan, as outlined by Haddad et al. (2024). According to these studies, 21% of Jordan's rangelands are suitable for MWH. Using this data, we upscale the model to reflect the broader potential benefits and costs of applying MWH across Jordan's rangelands. Costs are estimated based on labour, equipment, and planting materials, while benefits are derived from increases in grazing fodder and recreational opportunities, as documented in the experimental documentation in Haddad (2021). Given the time lag between the initial restoration costs and the subsequent benefits, we simulate two scenarios to capture this temporal aspect: a short-run cost scenario and a long-run benefits scenario**.**

3. Expected results

We expect the results to demonstrate the significant importance of incorporating non-market environmental services into the economic analysis of environmental policies. Specifically, the restoration of rangelands through MWH is anticipated to have a positive multiplier effect on the Jordanian economy. The increased availability of natural pasture would reduce the cost of livestock production by substituting purchased, subsidized feed with locally sourced forage. This substitution is expected to lead to an increase in livestock production, particularly small ruminants, and a reduction in the prices of meat and dairy products. The rural poor, especially those directly involved in livestock production, are expected to experience welfare gains mainly because of the increased income from labour demand for livestock production.

Additionally, the reduction in imported barley feed, which is heavily subsidized by the government, could significantly alleviate fiscal pressures and improve the national budget deficit. The inclusion of non-use values, such as the recreational and aesthetic value of rangelands, is also expected to improve household welfare through increased consumption of these landscape services. This integration of non-market values will provide a more accurate measure of the true welfare gains from rangeland restoration, thus helping policymakers make more informed decisions.

In conclusion, this study highlights the importance of applying a general equilibrium approach to the economic analysis of environmental restoration. By considering both market and non-

market effects, our model provides a comprehensive understanding of the potential benefits of rangeland restoration in Jordan, particularly through the adoption of micro water harvesting techniques. The findings are expected to offer valuable insights for policymakers seeking to balance environmental conservation with economic development in the country.

4. References

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